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TWO NEW CONODONT GENERA FROM THE JOINS FORMATION (LOWER MIDDLE ORDOVICIAN) OF OKLAHOMA

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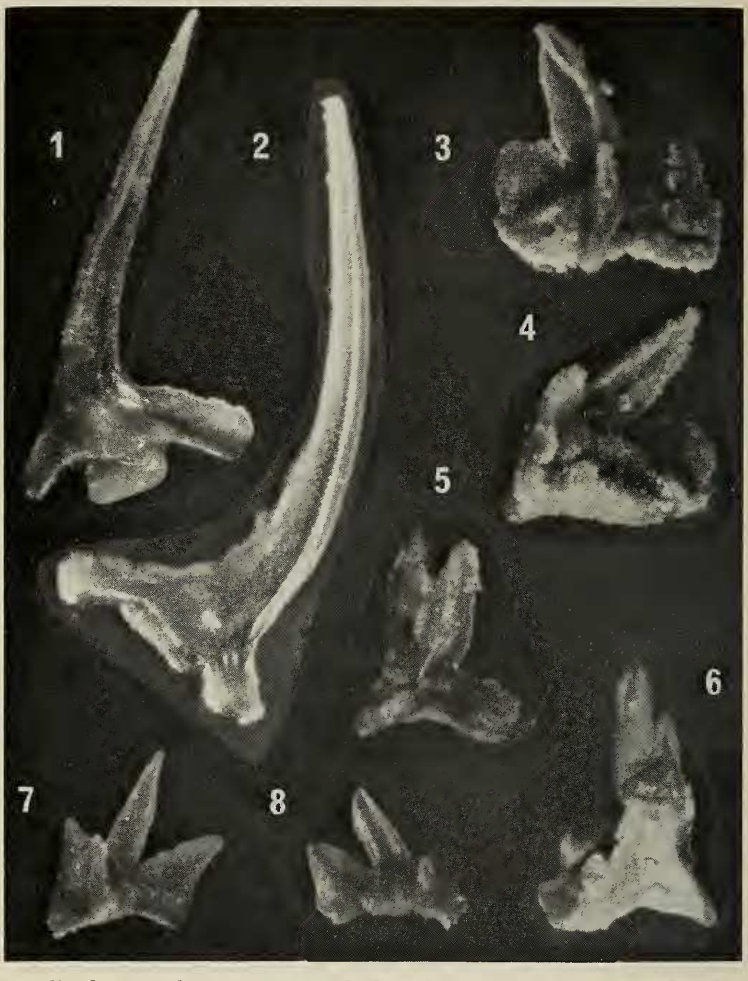
Conodonts have been reported from the Joins Formation of the Arbuckle Mountains, Oklahoma, by Gatchell, 1948; Harris, 1957; and more recently by Harris, 1962, 1964, 1964a. Part of a broad program of the investigation, distribution, and composition of conodont faunas in Ordovician rocks currently being followed at California Research Corporation includes the forms recovered from various strata in Oklahoma. The present study is based on conodonts recovered from continuous samples collected from the base to the top of the Joins Formation by A. R. Loeblich, Jr., along U.S. Highway 77 on the south side of the Arbuckle Mountains, SE 1/4 sec. 24, T.2 S., R.1 E., Carter County, Oklahoma.[1]

Harris (1962: 199) described briefly the geologic setting of the Joins Formation along U.S. Highway 77 in the southern Arbuckle Mountains. The Joins is here underlain conformably by the West Spring Creek Limestone of the Arbuckle Group and overlain by the sands of the Oil Creek Formation of the Simpson Group. Harris (*loc. cit.*, p. 200) included the Joins and Oil Creek Formations in the Chazyan Stage, which he assigned to the uppermost Canadian Series. Sweet (1963: 506) questioned this assignment and pointed out that the Joins graptolite fauna was representative of the *Didymograptus bifidus* Zone; moreover, the brachiopods *Desmorthis neva-*

[1] The author gratefully thanks Helen Tappan Loeblich and Alfred R. Loeblich, Jr., who offered aid and suggestions in the method of illustration followed herein. Thanks are also expressed to California Research Corporation for permission to publish this portion of the Ordovician studies.



All photographs are unretouched and are of ammonium chloride-coated specimens. Fig. 1—*Eoneoprioniodus cryptodens* n. gen., n. sp. Holotype. USNM 146268—Joins Formation, 40–45 feet above base: lateral view, showing microdenticles and cylindroidal basal plug (×50). Fig. 2—*Eoneoprioniodus cryptodens* n. gen., n. sp. Paratype. USNM 146269—Joins Formation, 165–170 feet above base: lateral view, showing tendency for stratigraphically younger specimens to develop antero-lateral shift of anterior keel (×37). Figs. 3–6—*Tricladiodus clypeus* n. gen., n. sp. Holotype. USNM 146271—Joins Formation, 0–5 feet above base (×37). 3) outer lateral view, showing basally expanded plate-like posterior denticle. 4) inner lateral view. 5) oral view, show-

densis and *Anomalorthis* probably placed it in the Whiterock Stage (Berry, 1960; Cooper, 1956; and Amsden, 1957). Strata below the McLish Formation (Marmor of Cooper, 1956, and Chazyan of Kay, 1940) classed thusly as Whiterock would, in the sense of the above authors, be pre-Chazyan and definitely post-Canadian. Chenoweth and Hansen (1964: 854) indicate a Champlainian assignment for the Joins and Oil Creek.

A review of the historical background of Simpson stratigraphic nomenclature is given in Harris (1957: 10–54) along with a description of the Simpson formations (*loc. cit.*, p. 54–103).

Study of conodonts recovered from the Joins Formation, including topotypes of Harris' (1962) fauna, indicates a strong affinity of the Joins conodonts to those from well-known Lower Middle Ordovician faunas, such as the Dutchtown fauna of Missouri.

Type specimens have been deposited in the United States National Museum (Smithsonian Institution), Division of Invertebrate Paleontology, Washington, D. C.

Systematic Paleontology

Eoneoprioniodus, new genus

Type species: *Eoneoprioniodus cryptodens*, new species.

Diagnosis: Simple conodont elements characterized by a drepanodid to scandodid cusp plan, an anterior process produced into an anticusp in the neoprioniodid structural scheme, and a posterior process extending posteriorly as a low quasi-denticulate bar.

Cusp varies from being essentially biconvex, smooth, acostate, and having well-defined anterior and posterior keels, to appearing decidedly asymmetrical and flexed. Posterior keel continues onto oral surface of posterior process as a distinct flange composed of numerous unerupted microdenticles. Anterior keel may be restricted to anterior margin in drepanodid specimens or may migrate to an antero-lateral position above the anticusp. Variations in symmetry are common and undiagnostic.

Basal cavity large and deep, conical in lateral view. Outline of cavity is anteriorly concave upward and posteriorly convex upward.

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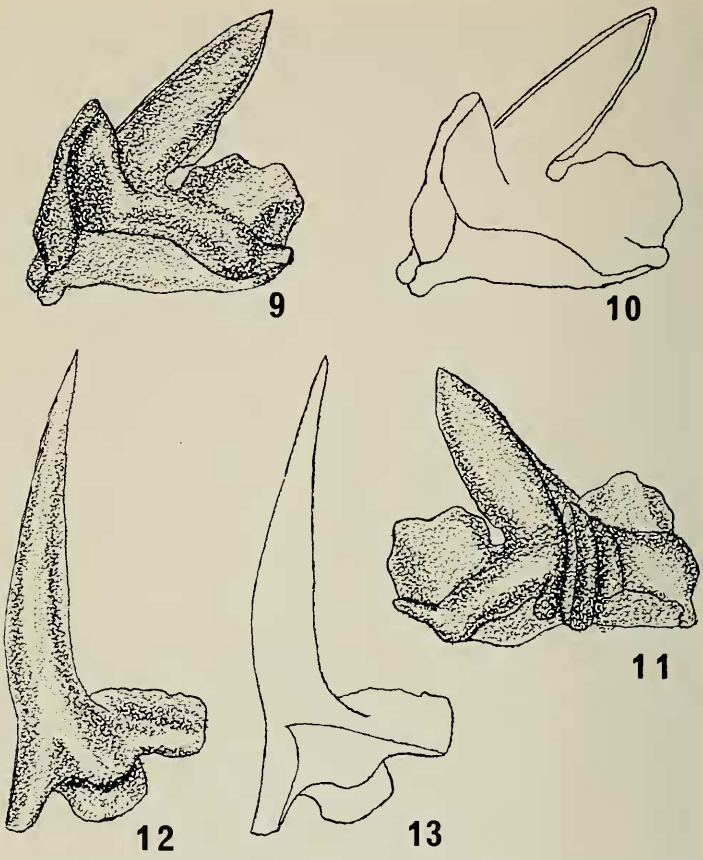
ing anteriorly flattened cusp face. 6) postero-aboral view, showing pyramidal basal cavity and filling. Figs. 7, 8—*Tricladiodus clypeus* n. gen., n. sp. Paratypes. USNM 146272, 146273. Both are outer lateral views. Joins Formation. 7) USNM 146272; 0–5 feet above base (×50). 8) USNM 146273; 15–20 feet above base (×37).



All figures ×47, camera lucida drawings. Figs. 9–11—*Tricladiodus clypeus* n. gen., n. sp. Holotype. USNM 146271. 9) inner lateral view. 10) same, showing pyramidal outline of basal cavity. 11) outer lateral view, showing proximal erismodid lip. Figs. 12, 13—*Eoneoprioniodus cryptodens* n. gen., n. sp. Holotype. USNM 146268. 12) lateral view, showing cylindroid plug. 13) same, showing concavo-convex outline of basal cavity.

Excavation extends over entire aboral surface, continuing to the antero-basal margin of the anticusp. A characteristic cylindroid basal plug of dense, granular material is common to many individuals. Basal margin sinuous, bears a narrow lip.

Remarks: *Eoneoprioniodus* is characterized by its blunt, anteriorly directed anticusp, large and deep basal cavity, posterior bar and pos-

terior keel, microdenticles, anterior keel, sinuous basal margin and cylindroid basal plug.

Eoneoprioniodus most closely resembles some species of *Neoprioniodus* Rhodes and Müller, 1956. It differs from the latter genus by lacking the well-developed denticles on the posterior bar which are so characteristic of *Neoprioniodus*. Most noticeably, *Eoneoprioniodus* possesses a basal cavity of great depth, more closely resembling a drepanodid in the cavity's general concavo-convex lateral outline than the broad, shallow, subapical pit which extends as grooves into neoprioniodid limbs.

Etymology: *Eo*, Gr. *eos*: dawn; refers to the presumed possible ancestry of *Neoprioniodus*.

Eoneoprioniodus cryptodens, new species
(Figs. 1, 2, 12, 13)

Diagnosis: Cusp smooth, flattened, simple, erect to recurved, unequally biconvex, flexed inward, slightly asymmetrical and having a basic scandodid plan. Anterior and posterior edges keeled; anterior margin sinuous in the plane of flattening. Anterior portion produced aborally into an anticusp as an anteriorly directed thick, blunt, prong-like process. Antero-basal margin curved smoothly, joins aboral margin at an abrupt angle. Posterior margin of cusp joins oral surface of base smoothly at an approximate angle of 90°. Posterior process minutely denticulated, developed as a continuation of posterior keel onto distal portion of posterior limb. Keel continues posteriorly as a fringe-like blade with numerous unerupted and partially erupted denticles appearing as surface serrations (microdenticles). Posterior limb is nearly straight but may be bowed inward slightly. Anterior process (anticusp) shorter than posterior bar, lending a "weighted" appearance to the posterior portion.

In lateral view, the basal margin is sinuous, broadly convex upward, and interrupted by a strongly erismodid median portion which is convex downward. A narrow lip serves to reinforce the basal margin.

Basal cavity is extremely deep and greatly excavated, extending from tip of antero-basal junction to postero-basal extremity. In lateral view, the basal cavity is conical in shape, having a strongly concave anterior outline and a gently sloping flatly convex posterior curve. Apex of cavity is a sharp tip, located close to anterior margin. A growth axis is readily observed in some specimens to arise from the tip of the basal cavity to the tip of the cusp. Interlamellar spaces are clearly visible and trace a somewhat erratic growth pattern which is seen to be slightly reflected externally in the expression of the flexed cusp. Basal excavation filled with a cylindroidally shaped plug of granular material.

Remarks: There is a marked tendency for specimens from higher beds to possess an increasingly scandodid scheme of morphology. In these stratigraphically younger specimens, the location of the anterior keel

has shifted over to an antero-lateral position on the inner lateral face of the asymmetrically biconvex cusp. Another variation is found in a group which is not restricted to the younger beds. This latter group possesses a basal cavity of unusually large proportions, occupying nearly the total basal area. In this case, the basal sheath is larger, the basal margin's sinuosity is reduced and the anterior and posterior processes approach equality of length. Either or both of these groups might represent discrete species categories, but the material at hand seems to indicate a gradual set of mixed variations more characteristic of a single species.

Dimensions of holotype: Maximum length, 1.3 mm; basal stretch, 0.5 mm; length of posterior bar, 0.4 mm; length of anticusp, 0.3 mm.

Occurrence: Common in lower Joins strata, rare in upper beds.

Material studied: 106 specimens.

Repository: Holotype, USNM 146268; figured paratype, USNM 146269; unfigured paratypes, USNM 146270.

Etymology: *Crypto-*, Gr. *kryptos,* hidden; *-dens*, L. *dens,* tooth; refers to the unerupted nature of the microdenticles of the posterior bar.

Tricladiodus, new genus

Type species: *Tricladiodus clypeus,* new species

Diagnosis: To this genus belong compound conodonts having a dominant cusp and three denticulated limbs: two antero-lateral and one posterior. The two antero-lateral processes branch off from the main cusp as denticulate bars.

Cusp is characteristically flattened anteriorly and has a lateral carina at each of the anterior margins. Posterior margin of cusp is sharp and bears an indistinct keel. Anterior face of cusp passes aborally and laterally into anterior faces of the two lateral limbs.

The entire unit is subsymmetrical and bowed sharply inward. Each of the three main processes bears a flattened fin-shaped denticle that ornaments a thick, tubular to biconvex bar.

Base expanded, basal margin uniformly convex upward in lateral and anterior views. A deep, pyramidal basal cavity of large proportions extends as deep grooves to the extremities of each process. Apex of basal cavity is located directly beneath the cusp.

Basal cavity of most specimens contains an irregularly shaped mass of dense, granular material.

Remarks: *Tricladiodus* is best characterized by its triangular basal outline, three accessory processes and pyramidal basal cavity.

Tricladiodus most closely resembles *Microcoelodus* Branson and Mehl, 1933, from which entity it differs by possessing an anteriorly flattened main cusp, three distinct denticulated tubular limbs and relatively simple plate-like denticles.

Etymology: *Tri-*, Gr. *trion,* three; *clado-*, Gr. *klados,* branch; *-odus,* Gr. *odous*, tooth; refers to the three denticulate branches or limbs which characterize this genus.

Tricladiodus clypeus, new species
(Figs. 3–11)

Diagnosis: Entire unit subsymmetrical or slightly asymmetrical, consists of two antero-lateral processes and one posterior bar radiating from a conspicuously dominant cusp. Unit is sharply bowed inward.

Cusp stout, pyramidal, triangular in cross-section, reflects the general contour of the basal outline. Anterior face of cusp a flattened curving plane that passes into the anterior faces of the two antero-lateral processes. Posterior margin of cusp is keeled to level of base and posterior bar. Cusp meets base at an angle of about 60°. Lateral faces of cusp are smooth and highly convex.

Posterior process is a thick tapering tubular bar whose distal extremity terminates in an upward flare. A single large plate-like denticle is inclined posteriorly in alignment with cusp. Base of blade-like bar denticle is nearly as long as entire posterior process.

Inner lateral process is a thickened tubular bar bearing one (most commonly) or more fin-shaped biconvex denticles; outer lateral process shorter than inner. One flattened narrowly biconvex denticle extends the length of the latter's tubular bar. Proximal portion of outer lateral bar produced aborally into an erismodid lip.

Basal margin convex upward in lateral and anterior views. Basal cavity moderately deep, pyramidal. In aboral view, basal cavity has the outline of an isosceles triangle with concave sides. Basal excavation continues as deep grooves to extremities of aboral surfaces of processes. Apex of cavity below main cusp.

Remarks: *Tricladiodus clypeus* is characterized by its simple fin-shaped denticles, subsymmetrical disposition of the denticulated processes, and its anteriorly flattened dominant cusp. Variations departing from this basic plan are common in middle Joins strata. Some specimens, possibly representing another species, are most strikingly dissimilar compared to typical *T. clypeus* in the position of the outer lateral process. In these latter cases, the outer lateral process is markedly reduced in size to a degree suggestive of a natural grouping of a different species. In addition, the process is swung forward and the outer lateral costa of the dominant cusp acquires a keel.

Some forms of *Dichognathus* Branson and Mehl, 1933, are similar to *Tricladiodus clypeus*. In species of the former genus, however, the outer anterior lateral process is reduced to the status of an undenticulated anterior bar joined to the outer side of the main cusp.

Tricladiodus clypeus differs from species of *Prioniodus* Pander, 1856, in possessing three equidenticulate processes, each bearing a single fin-shaped denticle. The flattened anterior face of the main cusp of *T. clypeus* also serves to distinguish it from closely allied forms.

Dimensions of holotype: Overall length, 0.8 mm; length of dominant cusp, 0.5 mm; length of posterior denticle, 0.3 mm; basal stretch, 0.7 mm.

Occurrence: Rare in lower Joins strata; restricted to lower 30 feet.

Material studied: 35 specimens.

Repository: Holotype, USNM 146271; figured paratypes, USNM 146272–146273; unfigured paratypes, USNM 146274.

Etymology: *Clypeus*, L. *shield*; refers to the shield-like or fin-shaped biconvex denticles on each of the processes which characterize this species.

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